



Keynote Address by

# Shri Kapil Sibal

Hon'ble Minister for  
Science & Technology and Earth Sciences  
Government of India

On the occasion of the

96<sup>th</sup>  
Indian  
Science  
Congress

**96<sup>th</sup> Indian Science Congress**

North Eastern Hill University  
Shillong, Meghalaya

January 3-7, 2009

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## **Science Education and Attraction of Talent for Excellence in Research**

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Dr. Manmohan Singh ji, Hon'ble Prime Minister of India; His Excellency Shri Ranjit Shekhar Mooshahary, Governor of Meghalaya; Dr Donkumar Roy, Hon'ble Chief Minister of Meghalaya; Dr T. Ramasami, President of the 96<sup>th</sup> Indian Science Congress; Professor M.G.K. Menon, Chancellor, North Eastern Hill University, Shillong; Professor C.N.R. Rao, Chairman, Scientific Advisory Committee to the Prime Minister; Prof. Ramamurthi Rallapali, Immediate Past President of the Indian Science Congress; Dr. G. Madhavan Nair, the President-elect of the 97<sup>th</sup> Indian Science Congress; Professor Pramod Tandon, Vice Chancellor, North Eastern Hill University, Shillong; Professor Avijit Banerji and Professor A. K. Saxena, General Secretaries of the ISCA; Members of the ISCA Council; distinguished scientists, respected delegates from abroad, media personnel, invitees, ladies and gentlemen.

1. Sir, I am fortunate to have the signal honour of addressing the prestigious Indian Science Congress for the fifth consecutive occasion and I am happy to see that with every passing year, the Congress is enriched with several new activities. This year is no exception.
2. This Science Congress is unique. For the first time, it is being held in the North East Region, special to us in many ways. Far, yet close to our hearts. Rich in

diversity, yet an integral part of our nationhood. Vivacious yet serene. Crying for change yet rooted in tradition. Has respect for its past, yet ready to leapfrog into the future. A future full of hope and promise.

3. Relatively untouched by massive industrialization, the North Eastern Region is rich in biodiversity. It has the benefit of a societal culture which accords women a status at par with men. The region has the wherewithal that can help enjoy the enormous benefits available through inputs in science and technology. The region can be showcased as the one that can, through science and technology, carve for itself the path of sustainable development for other regions of India to emulate.
  
4. Sir, history bears testimony to the fact that the march of any civilization has been on the shoulders of science and technology. William Russell aptly, once said "***Almost everything that distinguishes the modern world from earlier centuries is attributable to science***". Technology too has had a significant role to play in our civilizational march. It delivers the fruits of science for societal benefit.

While science continues to delight, excite and challenge, technology offers leisure, comfort and relaxation - both have contributed enormously to

enhancing human welfare in a myriad ways. This scientific enterprise has provided phenomenal understanding of our bodies, our minds, our world and our universe. Science has opened new vistas of knowledge, transforming human interaction and social structures. Science and technology also offer enormous economic opportunities, which fuel economic growth.

5. Sir, we are today living in an era of great economic, social and more importantly anthropogenic change. The growth of human population and the consequent consumption of natural resources is altering planet Earth in unprecedented ways. The world is also changing in a myriad other ways. Inequity within and among all nations has increased; new infectious diseases have emerged; technology, communication and information systems have undergone revolutionary changes; markets have become global; the biotic and cultural worlds have been homogenized; the rate of transport of people, goods and organisms has increased exponentially; multinational corporations have emerged as dominant economic players; and the role of non-governmental actors has assumed significance. Integration of the human dimensions of these global changes with the physical-chemical-biological dimensions is a necessity.

6. To meet the complex challenges confronting us, we need to invest in education to ensure that we can avail of a critical mass of educated human resource to provide us with the necessary solutions. Education must be considered a national priority. The present situation does not inspire confidence. Until recently out of every one hundred children who passed high school, only eight became graduates. Such a high rate of attrition is not conducive for generating a critical mass of students necessary for science to flourish. Our numbers must swell. Our quality must improve. Increased access at the University level coupled with improved standards should be our goal.
  
7. Though attempts have been made to achieve the above objectives, they have thus far not had the desired results. However, the outlay for education has been showing a consistent growth from a meagre Rs 150 crores in the First Five Year Plan. In the year 2005-06, the outlay for elementary education and literacy alone was Rs 12,700 crores and another Rs 2,700 crores for higher education. The 11<sup>th</sup> Five Year Plan saw a four fold increase in outlays compared to the 10<sup>th</sup> Plan. The Right to Education Bill, making education free and compulsory for all children aged between 6 and 14 years, having been passed by the Union Cabinet in October and introduced in the Rajya Sabha last month reflects the much awaited national

commitment. Notwithstanding this initiative, we have no reason to be complacent. The pace of progress in literacy rates has been slow. Between 1961 and 1991, the literacy rate has gone up by a mere 23.9 percentage points, from 28.3 in 1961 to 52.2 in 1991. From 1991 to 2001 there has been a 13.36% increase. The literacy scenario is further characterized by wide inequalities among different sections of the population. Female literacy is abysmally low with half the country's women still illiterate. No less disturbing is the persistent rural-urban divide. The scheduled castes and scheduled tribes form two other specially disadvantaged population groups. Regional disparities are also cause for worry. At the top of the hierarchy, lies the state of Kerala that has an exceptionally high literacy rate of 90.92 %. In Bihar, Kishanganj district has the lowest literacy rate (31% for males and 18.49% for females).

8. Sir, at the tertiary level, things are better. India is a global source for world class professionals in varied fields of science, be it medical professionals, energy experts, chemical engineers, telecommunication professionals, software specialists, infrastructure developers and the like. In the year 2006-07, we had 3960 R & D institutions, 358 Universities/Deemed Universities, 13 institutes of national importance,

20,677 colleges enrolling more than 11 million students in higher education, out of which about one third are in science faculties. In the year 2005-06, the country produced about 7,500 Ph.Ds in science and technology. The number of patents filed increased from 8,503 in 2000-01 to 28,940 in 2006-07. The total number of scientific papers increased from 20,514 in 1996 to 40,062 in 2006. The numbers however conceal certain disturbing facts. India's contribution to world publications has increased only marginally from 2.1% in 1995-2000 to 2.3% in 2000-05. While most countries spend more than 2% of their GDP on research and development, India spent only 0.88%.

9. Sir, creation of avenues for absorbing high quality scientific professionals is as important as generating them. This is particularly significant, as the developed countries and multi-national corporations look upon India as a rich source of high quality scientists. The Ministry has therefore been taking up a host of initiatives to attract and retain the best minds in science. At least some of them deserve special mention here. We have set up DNA clubs in 23 states involving 3 lakh students, which seek to expose them to new opportunities in biotechnology. Innovative young Biotechnology awards have been instituted to identify and nurture young researchers with innovative ideas. A joint venture between DBT and the

Wellcome Trust, UK has been established to build and nurture talent of the highest international standards, in cutting edge biomedical research in India.

10. Sir, you are aware that a great multitude of Scientists and Technologists of Indian Origin (STIO's), dispersed throughout the world are willing and eager to contribute to Indian science. We are devising special programmes for this. The Ramalingaswamy Re-entry Fellowship encourages STIOs, who are interested, to return to India and work in areas related to life sciences and biotechnology. Last week, the Union Government created 30 posts of Distinguished Scientists in the Council of Scientific & Industrial Research to specially attract STIOs in multifarious scientific disciplines. Gender sensitivity is an important factor in nurturing a scientific human resource base. An innovative Women Scientists Scheme that facilitates re-entry of women in the age group of 30-50 to mainstream science and engineering has recently been launched.
11. Sir, it is a known fact that creativity and innovation get stifled in a straight jacket bureaucratic structure. My constant attempt has been to create a favourable innovation ecosystem where scientific management is practiced in a de-bureaucratic ambience. The one

legislation passed by both houses of Parliament in its December session, signaling the formation of an autonomous body namely, the Science & Engineering Research Board (SERB) will go a long way in achieving this end. Decks have been cleared for another path breaking legislation already introduced in the Rajya Sabha, namely the "Protection and Utilization of Public Intellectual Property" aimed at removing bottlenecks and giving incentives in the conversion of output of Universities, academic and research institutions to potentially useful products for public good. The Ministry is committed to do whatever it can for promoting innovation. It is my belief that government acts as a facilitator in institutionalizing knowledge acquisition, but the locus of learning rests in enterprises, both public and private. Historically, industry has been a critical source, user and diffuser of technological progress, associated skills and attitudes. Industry is therefore not just an input, but also a critical node in the development process. That is why, the Ministry is emphasizing on business partnership through Technology parks and related institutions. The Biotechnology Industry Partnership Programme (BIPP) and the Small Business Innovative Research Initiatives (SBIRI) - both have been designed and launched with this end in view through the sunrise sector of Biotechnology which is registering an annual growth of about 35%.

12. Sir, technological developments have given birth to and nurtured industrialized societies. With its more complicated division of labour, industrialization caters to a number of occupations requiring extensive formal education and training. Educated and technically trained manpower in an ever evolving knowledge economy requires constant up-gradation of knowledge and skills. To the extent that schools, universities and training institutes react to or anticipate needs, the curriculum, teaching facilities and retraining teachers need to be continually monitored and readjusted. Given the limited ability to anticipate the complex processes of economic and social development and the need to transform the functioning of our educational system, I am sure, the Science Congress will deliberate as to how the two issues can be addressed.
13. Sir, the teaching of science also needs to be refined substantially. The function of instruction should be to help the pupil develop new modes of inquiry rather than the acquisition and storage of information. Given the rate at which knowledge increases, it is extremely difficult for the teacher to attempt to continually update the content of information. The sheer explosion of knowledge creates an impossible burden on the student. We must help students develop skills of procuring information and its analytical examination.

14. Sir, allow me to digress for a while, to dwell upon some controversies in science and research. There is a growing demand that research should be utilitarian and result oriented. Resources should be spent on projects, which can offer quick and lasting solutions. Research grants should not be frittered away in esoteric pursuits. While I happen to be a very strong advocate for using S & T for societal benefit, I do not subscribe to the extremist view of discouraging research in basic science. Researchers in basic sciences need to be respected and valued just as their counterparts in industrial research. Society needs them. Let me recall the words of Madame Curie ***"Humanity needs practical men, who get the most out of their work, and, without forgetting the general good, safeguard their own interests. But humanity also needs dreamers, for whom the disinterested development of an enterprise is so captivating that it becomes impossible for them to devote their care to their own material profit. Without doubt, these dreamers do not deserve wealth, because they do not desire it. Even so, a well-organized society should assure to such workers the efficient means of accomplishing their task, in a life freed from material care and freely consecrated to research"***. A second controversy is that technological upheavals need to be deliberately slowed down. Technological

hegemony now tends to enslave humanity. Technology feeds on itself and more technology generates even more powerful and lethal solutions. Man has mastered more technology than what his wisdom and morality allows him to handle. Use of technology in wars can have devastating consequences. Terrorists use sophisticated technology to their advantage and in the process spread terror. My response is simple and straightforward. Technology is a tool. It is an instrument, which is value neutral and can be used for good and bad. The answer to the problem lies not in embracing a technology denial regime, but act in the belief that technology alone can provide answers to those who seek to misuse it.

15. Sir, I believe that indiscriminate use of technology continues to harm our environment. Issues of environmental pollution, climate change have assumed alarming proportions. But the truth is that technology alone can arrest and reverse the unacceptable trends in global warming. We require to invest hugely in research and finding solutions to environmental problems. As Francis Bacon said "***Nature cannot be commanded except by being obeyed. Let us learn the laws of nature, and we shall be her masters, as we are now, in ignorance, her thralls; science is the road to utopia***". Many a

times such solutions elude nations which do not have adequate human or financial resources. Establishing and implementing interdisciplinary mega international programmes of science research has become imperative. Sir, shared research infrastructure has become the order of the day. Presently, the initiative to conceptualize such mega science programmes are generally proposed by scientists of the developed world and implemented as international programmes. Sometimes scientists from the developing world are also involved, but more often than not they have no substantive role to speak of. Scientific and technological development in most of the developing world is still far behind that of developed countries. But Sir, we have made considerable progress in niche areas of science and technology. We have demonstrated our parity with the best in the world. With a growing national capability in science and technology, our scientists now have the ability to lead high-level international scientific programmes. I feel we should organize a few front-line mega international science programmes and draw participation of scientists from around the world. Let me just cite one case from India to buttress this.

16. The National Centre for Radio Astrophysics of the Tata Institute of Fundamental Research (TIFR) has built and operates the Giant Metrewave Radio

Telescope (GMRT). It is the most powerful radio telescope in the world operating at low radio frequencies. The GMRT consists of 30 fully steerable gigantic parabolic dishes of 45 metres diameter spread over a distance of 25 km. Fifteen years ago GMRT was one of the most challenging experimental programmes in basic sciences undertaken by Indian scientists and engineers. Today, astronomers from all over the world regularly use this telescope to observe different astronomical objects such as galaxies, pulsars and supernovae. Since then we have mounted a few other mega projects such as Accelerator based research, Plasma Physics, but most of these deal with particle physics. The demands of today and tomorrow call for such mega projects in understanding climate change, environment, life systems and energy forms and sources; also to develop newer agriculture techniques. With large mega projects, I see a strategic convergence of the needs and directions of the North and the South. I therefore urge the Science Congress to discuss and debate on the mega projects that we might wish to launch in collaborative mode.

17. Sir, we all recognise that the future is quite likely to involve increasing rates of change; greater uncertainty about responses of complex biological, ecological, social, and political systems; and more surprises. The world at the dawn of the 21<sup>st</sup> century is

fundamentally different from the one in which scientific enterprise has developed hitherto. Challenges for society are formidable and will require substantial information, knowledge, wisdom, and above all collaboration between the scientific community, policy makers and the public. Such unprecedented environmental and social changes pose a challenge to scientists to define a new social contract with society.

18. We do recognize and acknowledge that science is the pursuit of knowledge with an established process for inquiry, logic and validation. Scientists are curious about why things are the way they are and thus relish the fun and challenges of problem-solving. Traditional roles of science have been to discover, communicate, apply knowledge and to train the next generation of scientists. Society supports science because of the unbounded benefits realized in the past and anticipates further benefits in the years to come. Society currently expects two outcomes from its investment in science. The first is the production of the best possible science regardless of the area. This reflects "the expectation that scientists will search for the truth about how nature works, producing reproducible, independently verifiable results, logically consistent theories and experiments that explain patterns in nature".

19. The second part of the contract reflects the anticipation that the investment by society will lead not only to improvements in our understanding of the world but also the achievement of goals that society deems to be important – winning wars to conquer diseases, creating products and improving the quality of life of people consistent with sustainable development. This second component often weighs heavily in policy decisions about the allocation of funds by the government. As President John F. Kennedy stated, "**Scientists alone can establish the objectives of their research, but society, in extending support to science, must take account of its own needs**". Hence, both the rationale for public investment in science as well as specific decisions about the allocations of resources is tied to expected outcomes that are beneficial to society. The social contract then ought to reflect the commitment of individuals, groups of scientists and the science academies to focus their efforts to maximize their outputs for societal benefit.
20. This social contract *inter-alia* then represents a commitment on the part of all scientists to devote their energies and talents to the pressing problems of society in relation to their importance in exchange for public funding. The new and unmet needs of society include more comprehensive information,

understanding and technologies that help society move towards a more sustainable biosphere - one which is ecologically sound, economically feasible and socially just. Admittedly, science alone does not hold the power to achieve the goal of greater sustainability, but scientific knowledge and wisdom are needed to help informed decision making that will enable society to move towards that end. Sir, I have been striving hard to make the best use of scientific and research data our institutions have collected and collated for the maximum benefit of our people. Let me cite a few instances. We have made a new policy by which accurate and up-to-date geospatial data, an extremely vital component for planning at all levels is made available to all citizens and have created a soft infrastructure called the National Spatial Data Infrastructure (NSDI). A legislation is being initiated to position an independent regulator/authority so as to foster a flourishing geospatial industry in the country. Similarly a massive modernization of the Met services in the country is already in progress, which collates the innumerable land, oceanic and upper air observations and integrates it with a state of the art forecasting system assisted by the most sophisticated computers and scientists. We are also struggling to put in place an effective dissemination system so that the alerts and advisories of the Met department reach the maximum number of people. Development of people's friendly technologies is the

most important ingredient of our creed; the launch of solar powered cycle rickshaw (Soleckshaw), an economic and sturdy tractor (Krishishakti); the Open Source Drug Discovery (OSDD), drinking water from sea water projects, etc have been animated by the commitment of our scientists to the welfare of the common man.

21. Sir, I feel that new fundamental research, faster and more effective transmission of new and existing knowledge to policy and decision makers and better communication of this knowledge to the public are required to meet this challenge. Most of the time, the social contract has been broken – as has been abundantly demonstrated from the fact that the benefits of science and technology have not significantly reached the majority living in the developing world including India. Also the new information and communication technologies, despite their immense potential to deal with developmental issues for the dissemination of culture and education, bring forth new risks affecting not only fundamental individual rights such as the right to privacy, but also the safety of trade and even national security itself in the face of a growing potential for cyber and terror wars. This baffling conundrum is further reinforced when consideration is given to the potentially harmful consequences, for both individuals and for society's very texture, arising from

new findings in biology, particularly those bearing on genetic manipulations. Thus the importance of scientific engagement across society and the potential for science to contribute to good policy making and sound governance has never been greater. I am convinced that it is only science that will help us address the main challenges we face as a nation and as a planet to -

- tackle and adapt to climate change,
- ensure security against international terrorism,
- satiate the needs of a rising population for food, water and other natural resources, and
- combat the impact of human diseases such as pandemic influenza, bird flu and animal diseases such as foot and mouth and blue tongue.

22. Thus a new social contract conducive to establishing an egalitarian society that helps to tackle and solve the monumental problems of society is needed. In this, the collaborative efforts of users and beneficiaries and scientists are needed to build better analyses of cost-benefit risks that are relevant for on-the-ground decision makers. Collaboration between researchers and users is also needed to mould research priorities in ways that are conducive to assist both. To ensure that we make the right decisions,

now and in the future, I believe that there is a pressing need to:

- strengthen the level of high quality engagement with the public on all major scientific issues; and
- increase the number of people who choose to study science subjects and take up research and scientific careers.

23. Sir, two bottom-up mechanisms for such collaboration are firstly, community-based research projects, which allow local users and beneficiaries to influence the choice of research problems, participate in data collection and accept and integrate research findings; and the second is citizens' forums, which allow local users to influence technological choice. The contract should thus be a strong call for new research and management approaches to facilitate the investigation of complex, interdisciplinary problems that span multiple spatial and temporal scales; to encourage inter agency and international cooperation on societal problems; and to construct more effective bridges between policy, management, and science, as well as the public and private sectors. I am sure the Science Congress will dwell and throw light on some of these issues.

24. Sir, I am convinced that we need a society that is excited by science; values its importance for our

social and economic wellbeing; feels confident in its use; and supports a representative well-qualified scientific workforce. It is obvious that for this we need to continue our efforts to ensure a strong future supply of scientists, engineers and technologists and to unlock the talents of all people in the country to use science and technology to help them lead their lives more richly.

25. Society is increasingly user-driven. We depend on technology and other science to support our daily lives. As the pace of scientific development accelerates, so does the pace of change in society. But, in the absence of improved scientific literacy including an understanding of scientific evidence and risk, the public will be unable to make informed decisions for themselves and their families. They will not be able to contribute effectively to political and ethical debates surrounding such complex issues as GM foods, stem cell research, cloning, or nuclear energy. I believe as scientists, we should be doing much more to proliferate scientific literacy widely and pervasively than hitherto.
  
26. Given the unprecedented faith that our Hon'ble Prime Minister has reposed in science and technology and the confidence and support accorded by the Finance Ministry and the Planning Commission, we have

made good progress, especially in improving the number and quality of students pursuing R&D careers and the proportion of women participants in research. The INSPIRE and the PURSE programmes that you had launched a fortnight ago, Sir, are our Ministry's renewed endeavours in this direction. Given your support, we hope to be one amongst the top ten countries by the end of the Eleventh Five Year Plan period.

27. Sir, the two Ministries that you have entrusted to me have mounted several initiatives for the North Eastern Region. Hitherto only around 5% of our S&T funding went to this region. We are endeavouring to enhance that to 10% by the end of this Plan period. As an initial step, 60 colleges have already been provided a grant of Rs.50 lakhs each for strengthening their laboratory facilities and we are according the status and benefits of 'Star College' to several of the colleges in the region. Other initiatives include special programmes for value addition to local resources of the region such as for quality planting material, bamboo applications, etc. We are now establishing a nodal centre of the Ministry in Shillong to provide integrated, holistic technology based solutions for the

development needs of the region. Sir, given that the region is inherently prone to natural disasters, we in the Ministry of Earth Sciences are modernizing and strengthening the forecasting infrastructure by setting up automatic weather and seismology systems at several locations in the region. Further, to enhance the reach of science and technology to pupils and people in the region, we are making available publications and information material brought out by Vigyan Prasar and other agencies to schools and the public.

28. Sir, I am thus confident that the region due to its resource endowments, natural as well as human, in time to come, will set a new paradigm for science and technology based sustainable development that minimizes the consumption of natural resources and maximizes human value addition to capital resources.

**Thank You!**  
**Jai Hind.**

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Ministry of Science & Technology  
Ministry of Earth Sciences  
Government of India